although wheat was in poor condition at the end of January.—*W. M. Wilson.*

Wyoming.—The mean temperature was 22.2°, or 0.8° below normal; the highest was 54°, at Fort Laramie on the 28th, and the lowest, 12° below zero, at Sheridan on the 23d. The average precipitation was 0.82, or 0.20 above normal; the greatest monthly amount, 2.30, occurred at Sundance, and the least, 0.35, at Laramie.—*M. G. Renoe.*

JANUARY REPORT.

Missouri.—The mean temperature was 28.2°, or 1.1° above normal; the highest was 72°, at Mineralspring on the 1st, and the lowest, 16° below zero, at Steffenville on the 25th. The average precipitation was 5.19, or 3.34 above normal; the greatest monthly amount, 10.37, occurred at Grovedale, and the least, 1.05, at Bethany.

RIVER AND FLOOD SERVICE.

By PARK MORRILL, Forecast Official, in charge of River and Flood Service.

The *extreme and average stages of water* in the rivers for the current month are given in the following table. Increased precipitation and higher rivers are reported in all sections. The basins of the Missouri and Upper Mississippi are heavily covered with snow and ice, presenting conditions similar to those of the great flood year of 1881.

The following résumé of river stages and conditions of navigation in the respective streams is compiled from reports by the officials of the Weather Bureau at various river stations and section centers:

Hudson River. (Reported by A. F. Sims, Albany, N. Y.)—On February 1 an average of 6 inches of snow covered the Hudson watershed, and, in the Adirondack section, at the headwaters of the Hudson, 15 inches of snow remained on the ground. The ice in the river ranged from 18 inches at Glens Falls to 9 inches at Poughkeepsie. Ice harvesting became general on the 2d, the ice being excellent in quality but very uneven. Heavy rains on the 7th melted all the snow over the watershed, except drifts in the woods, leaving most of the ground bare. On the 8th the ice in the river was covered with water and much honeycombed, in fact it was even dangerous to venture upon. The ice in the Catskill Creek came down on the night of the 7th, and gorged at the mouth of the creek. The river rose at Albany at the rate of 3 inches an hour from 9 a. m. to noon on the 8th, and then fell 14 inches by the morning of the 9th. During the first week of the month the large ice harvesters in the Catskill district secured about half a crop. The quality of the ice improved toward the middle of the month; it became firmer, but was uneven on the under side; all harvesters prepared to resume cutting after more than a week's delay caused by mild weather. The high temperatures of the week ending February 23 again softened the ice, and the turbid water cut it on the bottom, so that the harvesting of ice had to be suspended again. The close of the month finds the ice in the Hudson not in condition to harvest; many small holes which made their appearance refuse to freeze over notwithstanding the last cold wave.

Susquehanna River and branches. (Reported by E. R. Demain, Harrisburg, Pa.)—No floods of importance occurred during the month. The greatest rise reported was 8 feet at Mifflin, on the Juniata, where the river rose from 5 feet on the 22d to 13 feet on the 23d. On the West Branch, the river was closed at Karthaus from the 1st to the 21st. Driftwood Creek was frozen up at Cameron from the 1st to the 22d, and closed again on the 27th. Keating had a closed river from the 1st to the 18th, and during the rest of the month there was more or less floating ice. At Renovo the river was closed until 10.30 p. m. of the 22d, when the ice broke up and began to move out on a rise of about 4 feet. The river was frozen over at Farrandsville until the 24th when the ice broke up and moved out, and in doing so became jammed about the gauge in such a manner as to prevent readings being made the remainder of the month. The ice broke up at Lock Haven at 9.45 p. m. on the 23d, and moved out on a rise of 6½ feet. The river closed with ice for the second time this season on the 28th. At Williamsport the ice began running out on the 24th with a rise of 4 feet, and the river remained open the rest of the month, but its surface was covered, or partly covered, with floating ice. On the North Branch the river was closed at Towanda until the 23d, when the ice broke up and moved away from the gauge, but did not flow out. The river was frozen over at Wilkesbarre till the 20th, when the ice moved out quietly without doing any damage. At Harrisburg the Susquehanna was closed from 4 a. m., January 27, till 2 p. m., February 7. The ice moved out on a rise of about 4 feet from about two-thirds of the channel, but on the Harrisburg side it remained unbroken from the shore to the third pier of the bridge, and for a short distance up the river for several days longer. The river rose 2.2 feet within half an hour after the ice began to move, due, probably, to a gorge below the city. A wall of ice from 20 to 30 feet high, extending from the Wrightsville shore to a point over half a mile out into the Susquehanna, rested on the dam below Wrightsville. Old residents state that they never before saw the ice left in such a condition. It had been piled up by the back water, and after the river fell the ice remained, and it is the opinion of river men that unless moved out by a flood it will stay there until melted away by the warm weather of spring. Two breaks are reported in the dam between Wrightsville and Columbia since the breaking up of the ice. Near the Wrightsville side the dam has been completely gutted for a space of 206 feet, allowing shad to pass up and down the river. The other break reported is on the Columbia side and is fully 150 feet long. A sudden fall of about a foot in the river was thought to be owing to this break.

Rivers of South Atlantic States. (Reported by E. A. Evans, Richmond, Va.; C. F. von Herrmann, Raleigh, N. C.; L. N. Jesunofsky, Charleston, S. C.; D. Fisher, Augusta, Ga., and J. B. Marbury, Atlanta, Ga.)—The low water in the James River which characterized the month of January continued until the 5th of February, when a rise occurred. The immediate effect of the increasing volume of water was to break up the ice which had formed during the cold snap in the last decade of January in the upper portion of the river. This was brought down to the falls of the James at Richmond and banked there until the water pressure was sufficient to carry it down the rapids. At a narrow bend in the river just below the city it again jammed, causing a decided rise. The stream left its banks and overflowed the adjacent lowlands and portions of the city along the docks. The jam was broken by the city tugs, and the rushing water carried away considerable material which had been caught unprotected, and broke vessels from their moorings. The damage to shipping property was, however, slight. After the back water had passed down, the river continued rising until the 8th, when it attained its maximum height of 11.9 feet. It then receded slowly until near the zero of gauge, where it fluctuated, under the influence of moderate rains, until the 21st. At this time heavy rains fell over the entire basin, and on the 22d the river again began to rise. The highest water of the month, 15.0 feet, was reached on the 24th, after which it slowly subsided. Considerable damage was done, especially in the low portions of the city. Shockoe Creek, a small tributary of the river, backed up, filling cellars and in many cases the lower floors of houses, while along the wharves the lower floors of steamship storage houses and sheds were from 3 to 6 feet under water. Streets near the docks were impassable except in boats and street-car service on Lester street had to be abandoned. The damage, though large, was not so extensive as it would have been had not information of the approaching high water been sent out. The various shipping lines had ample warning and had large gangs of men at work getting freight and other movable material out of the way. All the business interests whose places are liable to invasion from the waters of the river were kept fully posted. The damage was confined mainly to the tenants of dwellings who were unable to move to other quarters. The river was back in its banks on the 27th.

The rivers of North Carolina were low at the beginning of the month, but general light rains caused much higher stages by the end of the first week. Heavier rains on the 6th necessitated the first river warning of this season, and all the rivers, especially those in the eastern part of the State, rose sufficiently high to overflow lowlands by the 8th and 9th. The Roanoke reached a stage of 35.5 feet at Weldon, this being 8 feet above the danger line, and the Cape Fear at Fayetteville reached a stage of 36 feet, only 2 feet below the danger line. The warning issued by the Weather Bureau was of value in the saving of stock pastured on the low islands of the Roanoke. The rivers maintained relatively high stages throughout the rest of the month, which was generally rainy, though not excessively so. A secondary flood stage was reached on the 23d to 25th, overflowing some lowlands, but no damage has so far been reported. River beds continued fairly full of water at the end of the month, making further floods by moderate rains an easy possibility.

General and heavy rainfalls, with but few intervals of dry weather, produced two distinct freshets in the streams of South Carolina in February. The precipitation of the 5th and 6th swelled all of the streams to immense volumes. The rivers remained at high stages, and were navigable during the entire month. Considerable merchandise, which was delayed for the want of navigable water, was shipped upon the occurrence of this rise. The Wateree at Camden rose from 16.1 feet on the 6th to 29.7 feet on the 8th, reaching the danger line, 24 feet, early on the morning of the 8th. It again rose from 13.5 feet on the 24th to 22.1 feet on the 26th, remaining at a high stage the balance of

the month. The Pedee at Cheraw rose from 7.8 feet on the 6th to 31.4 feet, 4.4 feet above the danger line, on the 8th. The second freshet occurred in this stream on the 24th and 25th, reaching a 26-foot stage on the afternoon of the 25th. On the 5th the Congaree gauge at Columbia registered 2.4 feet. The stream rose rapidly during the 6th and up to 1 p. m. of the 7th, when it reached a gauge reading of 20.7 feet, or 5.7 feet above the danger line. The water receded slowly on the 8th, but declined rapidly on the 9th, 10th, and 11th. The stream rose 4.5 feet on the 25th and 26th. The Waccamaw at Conway rose slowly throughout the month. It reached the danger line, 7 feet, on the 28th. The Edisto at Edisto, and the Lynch at Effingham, rose slowly up to the 14th, when maximum gauge readings occurred. Like its close neighbor the Waccamaw, the Lumber River showed a steady rise throughout the month, reaching the danger line, 6.5 feet, on the 28th. The rise in the lower Pedee at Smiths Mills averaged 0.8 foot per day from the 6th to the 18th. On the 18th the gauge registered a depth of 17 feet, or 1 foot above the danger line. Following this date the stream declined slowly to a gauge reading of 14.4 feet on the 25th. Its downward course was checked by the heavy precipitation of the 25th, which caused it to rise to a 15.2-foot stage on the 28th. The Santee at St. Stephens was above the danger line from the 14th to the 18th. The flood waters on the lower river courses retarded work considerably on the rice lands. The streams were clear of ice the entire month.

More than the usual quantity of water was present in the Savannah River this February. At Augusta the 20-foot mark was exceeded at three different periods, namely, the 7th, 13th, and 26th. The heavy and excessive rains of the 5th, which were general over the entire drainage area of the Savannah River, produced a rise of nearly 12 feet in twenty-four hours and resulted in the highest river of the month, the other two rises being not nearly so great, although the duration of each was practically the same. Navigation was in no wise obstructed, the river boats making regular trips with full cargoes.

The frequent and in most cases heavy rains which characterized the month added considerably to the water supply of the Georgia streams, except the Etowah, which continued low to the close of the month. The most decided rise occurred in the Chattahoochee at Eufaula, Ala., during the twenty-four hours ending on the morning of the 12th, when a rise of 19.2 feet was shown on the gauge, and during the ensuing twenty-four hours the water reached the danger line, 30 feet, but began to recede before any damage occurred. This river has been at good boating stage all the month. In the Flint a steady rise is noted from the 1st to 18th, after which a gradual fall occurred each day to the close of the month.

Mobile River and branches. (Reported by F. P. Chaffee, Montgomery, Ala., and W. M. Dudley, Mobile, Ala.)—Well-distributed rains over its watershed caused good navigable stages in the Alabama River during the entire month. Heavy rains on the 11th and 12th gave the highest waters about the middle of the month, though there were no freshets or even danger-line stages. On the afternoon of the 14th the river stood at 24.2 feet on the gauge at Montgomery, which is the highest since February, 13, 1896. The rivers fluctuated quite rapidly during the latter half of the month, necessitating some expense to freight handlers in moving freights from low wharves to high ground or the reverse.

The Tombigbee River, which had remained abnormally low for some time past, was also navigable during the entire month and the river interests have reaped large benefits therefrom, as freight has been received in large quantities.

Ohio River and branches. (Reported by F. Ridgway, Pittsburg, Pa.; H. L. Ball, Parkersburg, W. Va.; S. S. Bassler, Cincinnati, Ohio; F. Burke, Louisville, Ky.; and P. H. Smith, Cairo, Ill.)—The ice in the Monongahela River ran out during the last day or two of January. A great deal of ice passed out of the Alleghany on the 6th, 7th, and 8th. Most of the ice from the upper Alleghany came out on the 10th, and just ahead of this ice between 6,000,000 and 8,000,000 bushels of coal passed down the river, after navigation had been closed for about fifteen days. The ice from the Cheat passed out during the 13th and 14th. On the morning of the 23d the water in the Pittsburg harbor was two feet above the danger line and still rising. The flood water came suddenly and unexpectedly in the night. Before serious damage was done, however, warnings were disseminated with the aid of a special detail of police, and movable property, liable to damage by water at a stage of 30 feet, was moved to places of safety. The river continued to rise all day, reaching a stage of 29.5 feet at 11.30 p. m. The flood water came out of the Monongahela River, but during the late afternoon the Alleghany River put out several feet of water and thus caused the dangerous stage in the Pittsburg harbor to continue several hours longer than it would otherwise have done. By 8 a. m. of the 24th the river had fallen to a 29-foot stage, by 8 p. m. to a 25-foot stage, and by 8 a. m. of the 25th to a 19-foot stage.

During the first week of February the rivers in the mountain sections of West Virginia were frozen over and navigation closed. About the 7th general and somewhat heavy rains caused a breaking up, and for several days a heavy run of ice, in the rivers. High waters were recorded at all points but the floods were not serious and interfered but little with navigation after the ice had run out. From this time until the 20th the rivers fell slowly but still maintained good boating stages. The heavy rains from the 20th to the 25th again filled all the rivers, especially those emptying into the Ohio and the Potomac. Sudden and heavy rises occurred and the danger lines at all stations were reached, and at some points exceeded. The heaviest of the floods occurred in the mountains and caused considerable damage to property along the rivers. Railroad operations were totally suspended at many points and much loss resulted. The Ohio at Parkersburg rose steadily from the 21st to the 25th, reaching its highest point, 37.9 feet, at 4.15 p. m. on the latter date. A great many manufacturing, dwelling, and business houses had to be vacated, but no serious damage occurred. The floods in the two Kanawhas were very great and occasioned a considerable loss of property, chiefly lumber and ties. At Charleston a large part of the town was under water and many people were compelled to move. At Parkersburg warnings were issued over fifty hours before the flood crest reached the city and all exposed property was moved and stored in safe places.

Twice during the month navigation on the Ohio at Cincinnati has been suspended. The severe cold snap of the latter part of January filled the river with floating ice and bound up its shores with thick ice. On the first of the month the Kentucky side of the channel at Cincinnati above the Louisville and Nashville Railroad bridge was gorged. Softer weather and rain set in however, which had the effect of clearing the river to some extent, but also of increasing the volume of water and it seemed that a February freshet was impending. An ice gorge formed near the mouth of the Licking River opposite Cincinnati which broke on the 3d, with trifling damage to Cincinnati river property. On the 4th the gorge at the Louisville and Nashville Railroad bridge broke and quietly passed down stream with a rapidly rising river, carrying away the immense ice floes in the harbor. Navigation was now partly resumed, the river continuing to rise rapidly. On the 8th a local warning was issued that the water would reach the danger line, 45 feet, probably in forty-eight hours. On this rise between 7,000,000 and 10,000,000 bushels of coal were shipped from Pittsburg and a light run of coal out of the Kanawha. Navigation was generally resumed and river business unusually good. By the 10th all fears of a serious freshet were removed and merchants in the lower levels of the city, and river men congratulated themselves upon their escape from an expected February flood.

Meanwhile the floating ice and drift sweeping down the river gorged at the Louisville and Nashville Railroad bridge at Henderson, Ky. The river for about 25 miles above that point was covered by an extremely menacing gorge of solid ice, in which logs, trees, and all kinds of débris were wedged. At the Henderson bridge the ice was piled 40 feet high, imperiling the bridge. On the 11th the water came to within 0.4 of a foot of the danger line at Cincinnati, and on the same day the gigantic gorge broke and passed down the river without damage. This gorge is declared to have been one of the most remarkable occurrences in the history of the Ohio River. The river now gradually receded. About the 20th of the month a showery condition of weather set in and there were remarkably heavy rains over the watershed of the Ohio, more especially the region feeding its southern tributaries. On the morning of the 22d the river had risen 11.5 feet in twenty-four hours. The river and rainfall reports and newspaper accounts of great rains showed that a flood, unprecedented in respect to its suddenness, was imminent. A warning was issued that 50 feet (5 feet over the danger line) would be reached at Cincinnati on the following morning and that the rise would ultimately reach about 60 feet. General attention was paid to the warning and great damage by water to goods and merchandise in cellars throughout the wholesale business districts usually in the flooded regions was averted by their prompt removal. On the morning of the 23d the rapidly rising river had exceeded the stage forecast for Cincinnati by 0.4 of a foot. Meanwhile the water had risen above the danger line at Portsmouth, Ohio, Catlettsburg, Ky., and Pittsburg, Pa. The remarkable features of the flood in the Ohio Valley this year were the sudden and almost simultaneous rise at all points and the great length of the crest of wave, promising a slow decline. At Cincinnati the river finally came to a stand at 9 a. m. of the 26th, having reached a stage of 61.2 feet. The timely warnings prevented any considerable actual damage, though the loss sustained in the way of suspension of business, expense of removing goods and other incidental expenses was very great. Lawrenceville, Ind., was saved from its previous fate in flood times by the new levee which withstood the pressure of the water.

It is a singular fact in connection with the Ohio River flood that during the twenty years preceding 1880, the maximum rise in the river did not once occur in February. Records show that since 1880, the highest stage of water at Cincinnati has occurred most frequently in the month of February, eleven out of the past eighteen years having experienced the maximum rise during that month. Since 1860 there have been only two higher stages than that of the past month. On February 15, 1883, the water rose to 66.4 feet, and on February 14, 1884, to the phenomenal height of 71.1 feet.

Ice began to break in the harbor at Louisville on the 3d, which permitted the partial resumption of navigation to up-river points on that date. The heavy floating ice formed a gorge about 20 miles below the city, which precluded the passage of boats in that direction. The gorge gave way on the 8th, and on the following day navigation was open to

all points. A nearly normal stage of water prevailed until the heavy rains of the 20th to 22d, which caused a rapid rise in the Ohio and tributary streams. The Kentucky River and its forks rose with almost unprecedented rapidity during the night of the 21st and 22d, and for some time apprehensions were felt for the safety of some portions of Frankfort, but the flood passed with only damage to roads, bridges, and culverts. All the smaller streams of Kentucky, especially those in the mountain districts, rose beyond their banks, sweeping away logs, sawed lumber, and in some cases small houses. Railroad tracks were submerged, washouts numerous, and traffic delayed. The loss of life was comparatively small, though many hundreds of persons were compelled to abandon their homes temporarily. Middlesborough and Pikeville suffered quite severely, portions of both places being under water for a considerable time. The water fell rapidly in the smaller streams after the cessation of the rain, but the Ohio continued to swell in volume until, on the 28th, it attained a maximum height of 35.4 feet at Louisville, the greatest stage since the disastrous flood of 1884. No damage of consequence resulted in Louisville or adjacent cities.

At Evansville the month opened with a low stage of water and a falling river. At about 3 a. m. of the 10th large quantities of ice began to float down the river at Evansville, which was generally supposed to be due to what was known as the "Wolf Creek gorge." By 7 a. m. the river was filled with ice from bank to bank, running at a rate of 4 to 6 miles per hour; by 9 a. m. the gorge was complete, and remained so until about 4 p. m. of the 11th. At a few minutes before 4 p. m. on the 11th the gorge broke and the ice began moving slowly in the channel, and moved out gradually, leaving the ice on each shore extending from 100 to 125 yards into the river. On the Indiana side it remained until moved out by boats; that on the Kentucky side was removed by the current. The ice was very thick in the river and piled from 6 to 10 feet above the water line. Not much property was exposed to damage, as but few boats had left the ice harbor in Green River, and those that had, returned before the gorge was formed. The water reached the danger line, 30 feet, during the nights of the 9th and 10th, rising 9.5 feet from the morning of the 9th to the morning of the 10th, this rapid rise being evidently due to the forming of the ice gorge below Evansville. The gorge gradually increased until it extended for nearly 9 miles above the city. The river continued rising until the 12th, remained at a stand until the afternoon of the 13th, and then fell until the 21st, when a second rise set in which brought the river up to 42.6 feet by the morning of the 28th. The lowlands adjacent to Evansville have been submerged since the 10th instant.

At Cairo navigation opened on the 2d and the ferryboat of the Three States Company resumed regular trips on the 3d. The quantity of ice in the Ohio decreased until the 5th, when the last of it passed out. A second run of ice commenced on the 11th and passed out during the night of the 11th and 12th. A third run of ice (the Evansville gorge) commenced passing about 5 p. m. on the 13th, increased in quantity until about 7 p. m., and decreased considerably during the night of the 13th to 14th. Small quantities of ice were passing on the 14th and 15th; the last passed out on the latter date. The river rose rapidly from the 6th to the 14th and from the 24th to the close of the month, reaching the danger line, 40 feet, on the morning of the 28th, with prospects of a much higher stage. The adjacent lowlands are being inundated. Reports from points along the river from Evansville to Cairo, relative to the Evansville ice gorge, show that very little or no damage was done by the ice as it floated down the river. River trade at Cairo during the past month has not been as good as in former years, due mostly to stagnation in the lumber trade. Heavy tows of coal passed Cairo, for the south, from the 16th to the 20th.

Tennessee and Cumberland rivers. (Reported by L. M. Pindell, Chattanooga, Tenn., and H. C. Bate, Nashville, Tenn.)—The month of February opened with very low water in the Tennessee. Navigation was dangerous to large boats but good for small ones. The rise from the general rains which fell on January 31 and February 1 ranged from 2 to 6 feet and produced an excellent logging tide on the 5th, which continued until the 13th. On this tide over 5,000,000 feet of logs arrived at Chattanooga from the headwaters; it was the largest flotilla of logs known in many years. Ice began to pass out of the Clinch River at Kingston on the night of the 1st and ceased on the 4th. Navigation opened at Kingston on the 2d. No ice passed Chattanooga during the month, and it is supposed that what came out of the Clinch melted before reaching that point. A good boating tide continued until February 20, when heavy rain occurred over the headwaters of the Clinch and Holston rivers, causing rapid rises in those waters, with heavy drift. The rainfall was 3.30 inches at Speers Ferry and over 2 inches at Bluff City. The rain was heavy over the entire watershed on the 23d, the greatest amount being 3.50 inches at Strawberry Plains, Tenn. The Clinch, Powell, Holston, French Broad, Little Tennessee, and Tennessee rose rapidly, but the Hiwassee was not materially affected, being lower than during any freshet since 1879. The last freshet in February occurred in 1893 and was 1.7 feet less at Chattanooga than that of 1897. On the night of the 22d Beaver Creek was higher by 12 feet than in ordinary high tide and higher than it has been in twenty-one years. Many houses were flooded; all bridges over the creek were swept away. The Tennessee reached its highest stage of 35.1 feet at Chattanooga at 6 p. m. of the 26th. The lower river was still rising at the end of the month.

The month opened with the Cumberland River frozen from Celina to the headwaters, and ice running from Celina to the mouth. Rain on the 1st caused a rapid rise and broke up the ice by the 5th; the river was clear with water ranging from 10 feet at head to 20 feet at mouth. Rains on the 5th to 8th caused another rise and maximum heights were recorded as follows: Burnside, 19.9 feet on the 8th; Carthage, 18.4 on the 10th, and Nashville, 23.1 on the 11th. A steady fall was recorded from this time till the 21st, when unusually heavy rains in the eastern portions of Tennessee and Kentucky caused a sudden and decided rise. At Burnside the rise was 15.6 feet in the twenty-four hours ending at 8 a. m. of the 21st, and 30.1 feet in the next twenty-four hours, putting the water at 51.5 feet, 1.5 feet above danger line, on the morning of the 22d. This was succeeded by a rapid fall and the water was about 8 feet at the close of the month. At Carthage the danger line was reached at 2 p. m. of the 23d, and a maximum of 37.7 was recorded on the 26th, and the month closed with the water at 35 feet. At Nashville the rise was rapid on the 22d and steady till the 28th, when the maximum of 37.6 feet, 2.4 feet below the danger line, was reached, after which it ran out rapidly. Navigation was open from the mouth to Carthage all the month, and above that point after the 5th, and the month closed with ample water and prospects good for heavy business on the river during March.

Mississippi River and minor branches. (Reported by P. F. Lyons, St. Paul, Minn.; F. J. Walz, Davenport, Iowa; F. Z. Gosewisch, Keokuk, Iowa; H. C. Frankenfield, St. Louis, Mo.; S. C. Emery, Memphis, Tenn.; R. J. Hyatt, Vicksburg, Miss.; and R. E. Kerkam, New Orleans, La.)—There has been no change in the upper Mississippi or the Minnesota rivers during the last month, both of them remaining frozen over. Accurate gauge readings could not be made but the height of the surface of the ice field at St. Paul was noted from time to time, and its sag or rise; from these it is estimated that if the water had been at liberty to rise about the gauge an average stage of 3 feet would have been registered. Accounts from the watersheds of both rivers indicate an accumulation of snow far in excess of what it has been in any other winter since 1888 and there has been no thaw which might liberate the snow and ice-bound water since early in January. A stage of water in excess of the maximum in 1888 and 1893 will very likely be attained some time this spring.

Southward to Davenport the Mississippi was frozen throughout the month, the ice varying from 12 to 24 inches in thickness. The ice began breaking up on the rapids above Davenport on the 21st, and on the 22d began moving out at that point, but was stopped by the cold of the night of the 22d, and was again frozen tight during the cold spell which followed. The ice has piled up considerably in the middle of the river above the Government bridge, and will possibly cause damage when it goes out, especially if it should move suddenly.

The river was frozen at Keokuk at the beginning of the month, the ice being 12 inches thick. During the night of the 3d to 4th the ice loosened on the Des Moines Rapids, running down and leaving about half a mile of open water at the station while the river remained gorged 500 yards south of the gauge. Farther loosening of the ice to the north on the 15th caused a sudden rise of 4 feet, which subsided after a few hours. The gorge south broke on the 17th, and on the 18th the river was free from floating ice, while a little shore ice remained in shallow water on the Illinois side. On the 22d light drift ice began running and was increased by new ice forming during the night.

There were no extreme stages at St. Louis. After the 5th the Mississippi remained at an excellent navigable stage, as did also the Illinois River for a considerable distance from its mouth. The ice remained gorged as far south as Louisiana and Clarksville on the 1st, and gorged again the same day above the bridge at Hannibal. It broke at the latter place during the night of the 4th to 5th. On the 8th the ice was once more firm at Burlington and as far south as Louisiana and Clarksville. It remained comparatively firm at Burlington until the 28th when it moved out in the channel, leaving, however, a large quantity of heavy shore ice. Ice passed St. Louis at various times during the month, but it was mostly soft and in limited quantities, not sufficient to interfere with navigation.

From St. Louis to Cairo there was little change during the mouth; the river was quite low during the first decade, but a good boating stage was maintained from the 11th until the close of the month. Below Cairo the river was falling at the beginning of the month and continued to fall until the morning of the 7th; the remainder of the month the river was generally rising, the rise being rapid from the 8th to the 16th.

During the first week in February the Mississippi from Cairo to Memphis fell about 6 feet, when a rise set in, which at Cairo amounted to 20 feet, the flood crest reaching that place on the 17th and passing Memphis three days later with a 16-foot rise, and a gauge reading of 25.1 feet. From the 20th to 25th the river remained nearly stationary. and then a second rise began which continued to the close of the month. The last rise caused considerable uneasiness, owing to the presence of so much water in the lower river and the reported floods in the Ohio. Floating ice, which at the end of January was obstructing navigation, disappeared on the 4th. Large quantities of drift passed Memphis during the 15th, 16th, and 17th, but no serious inconvenience resulted therefrom. The month as a whole was favorable for naviga-

tion, the weather being mild, with a good depth of water at all times, making it possible for coal men to move large fleets of coal barges, many of which passed down during the latter part of the month.

A fall of 9 feet occurred in the river at Vicksburg between the 1st and the 12th of the month and a 2-foot fall at New Orleans between the 5th and 14th. Thereafter, until the closing days of the month, there was a general rise, amounting to some 15 feet at Vicksburg and nearly 4 feet at New Orleans.

The Red River showed a general decline during the month, only one small rise occurring in the lower portion during the first ten days of the month and the river being below a navigable stage during the greater portion of the month above Alexandria except for the lightest craft.

There was a slight rise in the upper Ouachita during the first twelve days of the month, affecting the lower river but slightly. The entire river declined during the last half of the month, but there was enough water for navigation and for log floating in the middle and lower portions during the entire month.

Missouri River and branches. (Reported by L. A. Welsh, Omaha, Nebr., and P. Connor, Kansas City, Mo.)—From Bismarck, N. Dak., to the headwaters reports are received stating that the snow is deeper and the ice in the river thicker than ever before known in that section, with an excellent prospect for floods in the near future. Press reports state that at Chamberlain, S. Dak., the Pontoon Bridge Company has removed its bridge from the river in anticipation of the breaking up of the ice at an early day. Uneasiness exists among the settlers who are located on the bottom lands along the river, and all who can do so are preparing to move their property, or so much of it as is possible, to higher ground before the ice breaks up. Settlers who a week or two ago were disposed to laugh at the fears of their neighbors have now come to a realization of their danger. The fact that the water is at a very low stage and frozen nearly to the bottom in many places renders the danger all the greater in the event that the ice breaks up on the upper river before it does below, as was the case in the spring of 1881, at which time the floods caused so much damage along the lower Missouri. The snowfall has been so great this winter throughout the entire region drained by the Missouri River that if the ice breaks up on the upper river before it does on the lower, sending vast volumes of water down upon the firmly frozen lower portion of the river destructive ice gorges will be formed and damage and loss of life will certainly result.

Grave fears are entertained by the settlers living on the bottom lands along the James River. This stream, although extending for more than 1,000 miles in the two Dakotas, is hardly more than a creek when in its normal state, and is credited with being the longest unnavigable stream in the world. It is very crooked, and drains a wide extent of country. The rich bottom lands on its banks are thickly dotted over with homes, farms, and other property of thrifty and progressive settlers, many of whom will temporarily seek higher ground until the danger is over. Throughout the valley of the James River, which extends from Wells County, N. Dak., to where it empties into the Missouri River, a short distance below Yankton, are vast bodies of snow and ice, which, when melted, will fill the James Valley from bluff to bluff. Should the greater part of the snow go off with heavy rains, as is frequently the case with the spring break-ups of the Missouri and James rivers, the danger would be increased and the most destructive floods since those of the spring of 1881 would be experienced along the two streams.

At Omaha, the river continued frozen over during the month, except about 250 feet on the west shore, where the gauge is located. This open water is due to the hot water from the smelting works and distillery just above the Union Pacific Railroad bridge on which the gauge is located. During the greater part of the month teams and pedestrians crossed on the ice at a point about 1,500 feet below the bridge. At the close of the month the ice had become very weak and for at least 2 miles below the city it was unsafe to cross. A comparison of gauge readings with those of past years, shows that the present stage of water is considerably above the normal.

At the mouth of the Platte, 28 miles below Omaha, the ice broke on the 20th, and at 1.45 p. m. began to move out. At 7 a. m. on the 21st the reading of the gauge was 7.5 feet. At 7 a. m. on the 25th the reading was 11.7 feet. This rise was caused by the ice gorging 1 mile below Plattsmouth. On the 24th the river was again frozen over, the ice being thick enough by the evening of that date to permit pedestrians to cross. The river was frozen over at Plattsmouth at the end of the month, but the water had subsided to a normal stage. From midway between Plattsmouth, Neb., and Saint Joseph, Mo., to Kansas City, the river remained open throughout the month.

At the latter place the river was blocked by ice above and below Hannibal bridge until the 9th, when the ice began breaking up. A jam in the mouth of the Kaw broke up at 4.10 p. m. on the 15th. From the 9th there was considerable floating ice until the 24th, when the river became entirely clear, but floating ice reappeared on the 25th and lasted to the close of the month. On the 1st of the month the ice gorged at Hermann, Mo., resulting in a rise of several feet west of that place. As a consequence the river banks at Lexington, Mo., were overflowed on the 5th. The gorge at Hermann broke on the 8th.

Arkansas River. (Reported by J. J. O'Donnell, Fort Smith, Ark., and F. H. Clarke, Little Rock, Ark.)—The spongy ice gorge anchored in the vicinity of Spruces Island at the end of January broke off and was entirely dissolved by the 10th without doing any damage. During the month a navigable stage prevailed for the river boats as far west as Webers Falls.

The river, which was frozen at Dardanelle at the end of January, opened February 1, and no ice was reported after that date. The river declined during the first three days of the month, but on the 4th a slight rise set in that reached Little Rock on the 5th; it then declined at Little Rock and Fort Smith on the 6th, but continued rising very slowly at Dardanelle. Light rains about this time in western Arkansas and Oklahoma caused a general rise that set in on the 7th and continued through the 12th at Dardanelle and the 13th at Little Rock. The lower river continued to fall slowly from the 14th to 16th, and then rose for two days, afterward declining until the 26th, when it came to a stand, but was falling again at the end of the month. A boating stage was maintained throughout the entire month and there was no interruption of navigation by ice or drift. There was no marked rise or decided fall, the extreme fluctuation at Little Rock for the month being but 4.7 feet.

Rivers on the Pacific Coast. (Reported by W. H. Hammon, San Francisco, Cal., J. A. Barwick, Sacramento, Cal., and B. S. Pague, Portland, Oreg.)—At the beginning of the month unusually heavy rainfall throughout California led to a rapid rise in the American, Feather, and upper Sacramento rivers and in the San Joaquin in the vicinity of San Joaquin bridge. In the Sacramento Valley, owing to the peculiar course of the river channel and the unevenness of the levees, a large volume of water leaves the river channel and passes down the Yolo basin. Thus, while the lowlands are flooded, places along the river bank which are protected by strong and high levees are saved from danger by this very breaking down of the banks at some upper point. On the morning of the 5th the rising streams threatened floods in many parts of the State. At Stockton householders in the districts that were flooded three years ago made preparations for the removal of goods. East of Stockton the country was all under water. At Linden, near the Mormon channel, the water had not been so high for years. Between Linden and Belota the country was covered with water. There was fortunately but a small amount of snow in the higher regions, and the ending of the rain was quickly followed by a fall in the stages of the upper rivers. At the junction of the Sacramento and San Joaquin, however, the waters continued to rise slowly and a large area of land, which had been or would have been planted with wheat, was covered with water. In the extreme northwestern part of the State the Eel and Mad rivers were unusually high and much damage was done by the drifting logs.

The Sacramento River at Sacramento has ranged from 20 to 24 feet, in consequence of which the tule or swamp lands of Yolo County, opposite this city, have been one vast sea of water. The water is not as high in the tule or overflowed swamp land as it usually gets each winter or during the rainy season. There has been no dangerous or rapid rise in the river at this point to cause any alarm to be felt on either side of the river. The levees on the opposite side are lower than on this side and will only stand 28 feet, which is the danger line on the river gauge at this point, but some time before such a height is reached the little village of Broderick, opposite Sacramento, is flooded by back water from the overflowed tule basin of Yolo County. The time of danger to the levees in this vicinity is when heavy rains occur on the American River, and the crest of the flood from that river reaches this city at the same time that the crest of flood waters from the Sacramento River does; at such times the people patrol the levees both day and night if the gauge indicates 26 to 28 feet. Danger to the leveed districts of Yolo County some 20 to 30 miles below this city is from the flood waters of the tule basin flowing back into the Sacramento River through Steamboat and other sloughs in that vicinity. Until the river is thoroughly dredged and the levees raised to uniform heights, every winter immense bodies of water will flow from the river through these great tule basins and back again miles below the point where they first left the river.

The Willamette River was influenced by the rains in the forepart of the month, which caused the river to rise to a height of 13.5 feet at Portland. This height being below the danger line no damage resulted though some anxiety was felt by merchants and others relative to the future action of the waters. At the close of the month the river had fallen to the low-water mark for the month of February.

Heights of rivers above zeros of gauges, February, 1897.

Stations.	Distance to mouth of river.	Danger-line on gauge.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn.†	1,984	14	.....	.....	.....	.....	.....	.....
Reeds Landing, Minn.†	1,864	12	.....	.....	.....	.....	.....	.....
La Crosse, Wis.†	1,799	10	.....	.....	.....	.....	.....	.....
North McGregor, Iowa†	1,789	18	.....	.....	.....	.....	.....	.....

Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger-line on gauge.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Mississippi River—Cont'd	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Dubuque, Iowa†	1,679	15	... .	....	.....	.....	.....	.....
Leclaire, Iowa†	1,589	10	.....	.....	.....	....	.....	.....
Davenport, Iowa†	1,573	15	.....	.....	.....	.....	.....	.....
Keokuk, Iowa [a]	1,443	14	8.0	4	3.9	27	5.8	4.1
Hannibal, Mo	1,332	17	5.7	23	3.1	1	4.3	2.6
Grafton, Ill	1,284	23	8.8	25, 26	4.8	1	7.3	4.0
St. Louis, Mo.	1,241	30	15.4	25	4.8	2	10.8	10.6
Chester, Ill.	1,170	30	11.6	25	2.9	3	7.5	8.7
Cairo, Ill	1,078	40	40.0	28	14.0	4	28.0	26.0
Memphis, Tenn	843	33	26.4	28	8.0	7	18.3	18.4
Helena, Ark	767	37	33.8	28	14.2	7	25.3	19.6
Arkansas City, Ark.	635	42	35.1	23, 24	19.1	9	28.0	16.0
Greenville, Miss	595	40	30.0	23, 24	15.9	9, 10	23.5	14.1
Vicksburg, Miss	474	41	33.3	25, 26	18.0	12	25.9	15.3
New Orleans, La	108	16	11.2	27, 28	7.5	14, 15	9.2	3.7
Arkansas River.								
Fort Smith, Ark.	345	22	10.1	10	3.5	1–3, 6	6.6	6.6
Dardanelle, Ark.	250	21	8.8	26	3.3	5	5.8	5.5
Little Rock, Ark.	170	23	10.2	13	5.5	6	7.6	4.7
White River.								
Newport, Ark	150	21	13.9	12	6.1	4	9.4	7.8
Illinois River.								
Peoria, Ill.	135	14	13.8	26	10.6	17	11.8	3.2
Missouri River.								
Bismarck, N. Dak.†	1,201	14	.....	.....	.....	.....	.....	.....
Pierre, S. Dak.†	1,006	14	.....	.....	.....	.....	.....	.....
Sioux City, Iowa†	676	19	.....	.....	.....	.....	.....	.....
Omaha, Nebr.	561	18	9.7	1	8.3	18	9.0	1.4
Kansas City, Mo.	280	21	11.3	6	8.8	20	10.3	2.5
Boonville, Mo.	191	20	9.8	24	3.6	1	7.3	6.2
Hermann, Mo. [f]	95	21	8.5	23–25	5.7	12	7.1	2.8
Ohio River.								
Pittsburg, Pa	966	22	28.9	24	2.6	2	9.6	26.3
Davis Island Dam, Pa.	960	25	26.6	24	4.4	2, 3	13.3	22.2
Wheeling, W. Va. [b]	875	36	38.7	24	9.5	2	16.1	29.2
Marietta, Ohio [c]	795	25	26.0	25	10.1	6	20.7	25.9
Parkersburg, W. Va. [d]	785	38	37.9	25	8.3	5	20.3	29.6
Point Pleasant, W. Va.	708	36	52.3	25	3.5	1	26.8	48.8
Catlettsburg, Ky	651	50	58.5	25	6.2	1	32.6	52.3
Portsmouth, Ohio	612	50	59.0	25	5.7	1	33.7	53.3
Cincinnati, Ohio	499	45	61.1	26	10.1	2	36.3	51.0
Louisville, Ky. [d]	367	24	35.4	28	5.8	3	16.7	29.6
Evansville, Ind	184	30	42.6	28	9.0	2	27.1	33.6
Mount Vernon, Ind. [e]	148	35	41.9	28	10.5	6	29.4	31.4
Paducah, Ky.	47	40	36.4	28	9.7	3	23.6	26.7
Alleghany River.								
Warren, Pa	177	7	3.0	8	0.8	1–6	1.7	2.2
Oil City, Pa	123	13	7.4	8	1.8	1–3	3.1	5.6
Parker, Pa.	73	20	10.2	9	1.8	3–5	3.7	8.4
Freeport, Pa.	26	20	17.2	23	5.2	1	7.7	12.0
Conemaugh River.								
Johnstown, Pa. [a]	64	7	10.5	23	1.6	6	3.3	8.9
Red Bank Creek.								
Brookville, Pa.	35	8	4.1	24	1.0	1–6	1.7	3.1
Beaver River.								
Ellwood Junction, Pa.	10	14	15.3	9	1.8	1–6	4.8	13.5
Big Sandy River.								
Louisa, Ky.	26	20	46.6	23	5.3	1	17.7	41.3
Cumberland River.								
Burnside, Ky	434	50	51.5	22	3.2	1	16.0	48.3
Carthage, Tenn.	257	30	37.7	26	3.4	1	17.2	34.3
Nashville, Tenn	175	40	37.5	28	6.2	1	20.2	31.3
Great Kanawha River.								
Charleston, W. Va.	61	30	41.5	23	3.0	1	13.2	38.5
New River.								
Radford, Va.	153	14	11.5	22	0.3	1, 2	3.2	11.2
Hinton, W. Va.	93	14	12.9	24	1.1	1	5.7	11.8
Licking River.								
Falmouth, Ky. [d]	30	25	27.8	23	4.0	19, 20	10.4	23.8
Miami River.								
Dayton, Ohio	69	18	5.9	22	1.4	4	3.4	4.5
Monongahela River.								
Weston, W. Va. [b]	161	18	15.2	23	0.0	28	2.7	15.2
Fairmont, W. Va.	119	25	27.8	23	1.8	1, 2	6.4	26.0
Morgantown, W. Va. [a]	95	20	29.5	23	8.5	20	12.7	21.0
Greensboro, Pa.	81	18	33.5	23	7.5	1–4	12.6	26.0
Lock No. 4, Pa.	40	28	36.0	23, 24	6.7	1, 2	14.3	29.3
Cheat River.								
Rowlesburg, W. Va. [f]	36	14	13.5	23	3.0	{10, 11. 15} {16, 19, 20}	5.3	10.5
Youghiogheny River.								
Confluence, Pa.	59	10	13.6	22	1.4	5	4.5	12.2
West Newton, Pa. [f]	15	23	23.0	23	2.1	11	6.0	19.9

Heights of rivers above zeros of gauges—Continued.

Stations.	Distance to mouth of river.	Danger-line on gauge.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Tennessee River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Knoxville, Tenn.	614	29	26.0	24	1.8	1	7.0	24.2
Chattanooga, Tenn.	430	33	35.0	26	3.0	1	13.3	32.0
Bridgeport, Ala	390	24	24.3	27	1.5	1	10.0	22.8
Florence, Ala.	220	16	16.0	28	2.9	1	8.4	13.1
Johnsonville, Tenn.	94	21	20.1	28	5.5	2	12.5	14.6
Rockwood, Tenn	519	20	27.5	25	3.0	1	9.5	24.5
Wabash River.								
Terre Haute, Ind. [g]	165	16	16.1	23	7.0	14	12.9	9.1
Mt. Carmel, Ill. [a]	50	15	19.2	28	5.0	4–6	11.1	14.2
Red River								
Arthur City, Tex.	668	27	4.2	6	3.1	28	3.4	1.1
Fulton, Ark	565	28	5.2	11	2.7	28	3.8	2.5
Shreveport, La.	449	29	5.6	1	0.5	28	2.9	5.1
Alexandria, La	139	33	15.6	8	4.1	28	9.4	11.5
Atchafalaya River.								
Melville, La.	100*	31	27.6	28	22.3	15	25.1	5.3
Ouachita River.								
Camden, Ark.	340	39	13.5	12	7.0	28	9.6	6.5
Monroe, La	100	40	26.1	9	19.4	28	24.2	6.7
Yazoo River.								
Yazoo City, Miss.	80	25	14.0	27–28	8.3	3, 4	11.1	5.7
Tombigbee River.								
Columbus, Miss.	285	33	6.5	9	—0.2	23	3.0	6.7
Demopolis, Ala.	155	35	28.6	13	5.4	1	16.6	23.2
Black Warrior River.								
Cordova, Ala	155	20	9.0	12	4.4	20–22	6.2	4.6
Tuscaloosa, Ala.	90	38	25.9	13	3.9	1	15.1	22.0
Alabama River.								
Montgomery, Ala.	265	35	24.2	15	3.5	1	11.9	20.7
Selma, Ala.	212	35	27.5	15	2.6	1, 2	14.2	24.9
Coosa River.								
Rome, Ga	225	30	11.7	24	2.8	1	5.9	8.9
Wilsonville, Ala	66	15	7.6	26	3.0	1, 2	5.7	4.6
Tallapoosa River.								
Sturdevant, Ala.	69	15	3.0	9	1.0	15, 20, 22	1.8	2.0
Savannah River.								
Augusta, Ga	130	32	27.1	7	7.2	1	15.5	19.9
Edisto River.								
Edisto, S. C	75	6	5.9	14, 15	3.7	5	5.1	2.2
Congaree River.								
Columbia, S. C.	37	15	20.7	7	1.9	1	5.8	18.8
Santee River.								
St. Stephens, S. C.	50	12	13.7	15	7.3	5	9.5	6.4
Wateree River.								
Camden, S. C	45	24	29.7	8	5.2	1	15.1	24.5
Black River.								
Kingstree, S. C.	60	12	10.3	15	6.2	5	8.9	4.1
Great Pee Dee River.								
Cheraw, S. C.	145	27	31.4	8	2.7	1	15.1	28.7
Linch Creek.								
Effingham, S. C	35	12	14.0	14	5.8	1	10.3	8.2
Lumber River.								
Fairbluff, N. C.	10	6	6.5	28	2.8	1	5.0	3.7
Waccamaw River.								
Conway, S. C	40	7	7.0	28	3.2	1	5.2	3.8
Cape Fear River.								
Fayetteville, N. C.	100	38	36.5	8	5.5	1	19.2	31.0
James River.								
Lynchburg, Va. [b]	257	18	13.6	24	0.8	2	4.9	12.8
Richmond, Va.	110	10	15.0	24	—0.1	1	4.4	15.1
Potomac River.								
Harpers Ferry, W. Va.	170	16	24.5	24	1.4	1	7.6	23.1
Susquehanna River.								
Wilkesbarre, Pa. [b]	178	14	3.0	24, 25	1.0	20–22	.....	2.0
Harrisburg, Pa.	70	17	7.9	24	3.0	6	4.6	4.9
W. Br. of Susquehanna.								
Lock Haven, Pa.	68	10	6.5	23	0.5	1–6	1.5	6.0
Williamsport, Pa.	35	20	8.8	24	1.5	2–6	3.6	7.3
Juniata River.								
Huntingdon, Pa.	80	24	8.7	23	3.2	6	4.5	5.5
Sacramento River.								
Redbluff, Cal.	241	23	21.6	6	5.6	27	10.4	16.0
Sacramento, Cal.	70	28	24.2	9, 10	20.5	28	21.6	3.7
Willamette River.								
Eugene, Oreg	149	10	13.0	16	3.2	27	6.3	8.8
Albany, Oreg	99	20	18.4	17	5.0	26, 27	10.4	13.4
Salem, Oreg.	69	20	17.6	17	5.6	27, 28	11.0	12.0
Portland, Oreg.	10	15	13.5	17	3.5	27	8.7	10.0

*Distance to the Gulf of Mexico. †Frozen. [a] Frozen 1–3. [b] Frozen 1. [c] Frozen 1–5. [d] Frozen 1–2. [e] Frozen 1–6. [f] Frozen 1–7. [g] Frozen 1–13. [h] Frozen 1–19.

SPECIAL CONTRIBUTIONS.

WIND NOMENCLATURE.

By FRANK W. PROCTOR (dated April 2, 1897).

There is such variance of verbal usage among meteorologists in stating the direction of horizontal air movements, except when they are spoken of as winds, that it is frequently impossible to understand from the words used what the direction is.

The following quotations will serve as illustrations:

"Easterly current" [from the west].—FERREL.

"Westerly current" [from the west].—CLAYTON.

"Northeast current" [return polar current].—DAVIS.

"Southwesterly currents" [from southwest].—CLEMENT LEY.

"Easterly current" [from the east].—ABERCROMBY.

"West current" [from the west].—ABBE.

In speaking of *currents* of air all of the authors cited, save